Drought-Tolerant Hybrid Response to Crop Rotation and Tillage in the Eastern Corn Belt

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INTRODUCTION

- No-till production has been increasing in the eastern U.S. Corn Belt.
  - Continuous corn production may increase residue on soil surface and affect planting
- Wet springs in heavy clay soils
  - Limit early season root development
  - Increase likelihood of drought stress later in the season
  - Drought tolerant hybrids may provide increased yield stability
- Rotating corn with soybeans can increase yield
  - Hybrid response may vary with drought tolerance (root characteristics, nutrient and use efficiency)
  - Tillage may impact nutrient cycling and may impact hybrid response

OBJECTIVE

Assess drought-tolerant hybrid responses to cropping sequence and tillage system.

METHODS

- Field experiments conducted from 2013-2015 at South Charleston and Hoytville, OH
- Split-split plot randomized complete block design
- Whole plot factor: Annual tillage practice
  - No-tillage
  - Tillage (fall chisel + spring cultivation)
- Sub-plot factor: Cropping sequence
  - Continuous corn
  - Corn following soybean
- Sub-sub-plot factor: Hybrid (Table 1)

Table 1. Comparative relative maturity range and drought tolerance rating of hybrids evaluated each year.

Hybrid/Brand	Comparative Relative Maturity (d)	Drought Tolerance Rating[1]
P0210AMX	102	9 (Tol)
P0448AM1	104	7 (Con)
P1184AM1	111	7 (Con)
P1352AMXT	113	9 (Tol)

[1]Drought tolerance is rated on a scale of 9 to 1 with 9=excellent tolerance and 1 = poor tolerance.

- Four replications of the whole plot each year
- Every treatment was present every year
- Silk date recorded (day of the year or DOY)
- Stalk diameter measured at R5
- Grain yield and harvest moisture collected after R6 (adjusted to 155 g kg^{-1} moisture)

RESULTS AND DISCUSSION

Table 2. Silking date and stalk diameter as influenced by tillage, cropping sequence, and hybrid type. Letters denote significant differences between treatments within each factor.

	South Charleston		Hoytville	
Tillage	Silk Date (DOY)	Stalk Diameter (cm)	Silk Date (DOY)	Stalk Diameter (cm)
No-Tillage	208a	2.13a	206a	2.16a
Tillage	206b	2.16a	205b	2.18a
Crop Seq.				
Corn-Corn	208a	2.10b	206a	2.17a
Corn-Soy	205b	2.18a	205b	2.17a
Hybrid Type				
Conventional	207a	2.14a	206a	2.16a
Tolerant	207a	2.14a	206a	2.18a

Table 3. Grain yield as impacted by the interaction of cropping sequence and hybrid type. Letters denote significant differences between treatments within each location.

Hybrid Type	Cropping Sequence	South Charleston	Hoytville
		Grain Yield (Mg ha^{-1})	
Conventional	Corn-Corn	13.36c	9.47b
	Corn-Soybean	13.80b	10.16a
Tolerant	Corn-Corn	12.98c	9.85a
	Corn-Soybean	14.11a	10.16a

Silk Date and Stalk Diameter (Table 2)

- Silk date lengthened under no-till and continuous corn production, but did not affect yield (data not shown).
- Hybrid type did not influence silking date.
- Stalk diameter was influenced by cropping sequence at South Charleston, but a change was not evident at Hoytville.
- Tillage and hybrid type did not alter stalk diameter.

Grain Yield and Cropping Sequence Interaction (Table 3)

- Drought tolerant hybrids yielded 3% more than conventional hybrids at South Charleston in corn-soybean rotation.
- Drought-tolerant hybrids produced 4% greater yield than conventional hybrids under continuous corn at Hoytville.

Tillage and Rotation Legacy Effects (Figures 1 and 2)

- Continuous corn under no-till production exhibited the greatest relative yield drag over time
- Relative yield increased over time for hybrids grown under no-till and in rotation with soybeans
- Yield variability between treatments was greatest in 2015 where total precipitation for June through July was 175 and 94 mm above average (Figs.1 and 2, respectively).

STATISTICS

Data were analyzed within each site using PROC MIXED in SAS 9.4, with means separated using paired t-tests (significant Global F-test at α=0.05). Analysis for sub-subplot factor was conducted based on drought-tolerance designation, with individual hybrid means analyzed as subsamples. Tables were generated using data across years with year set as a random factor and replication nested within year. Figures were generated using annual data, and relative yield was calculated by dividing each plot value by the mean value for each site-year.

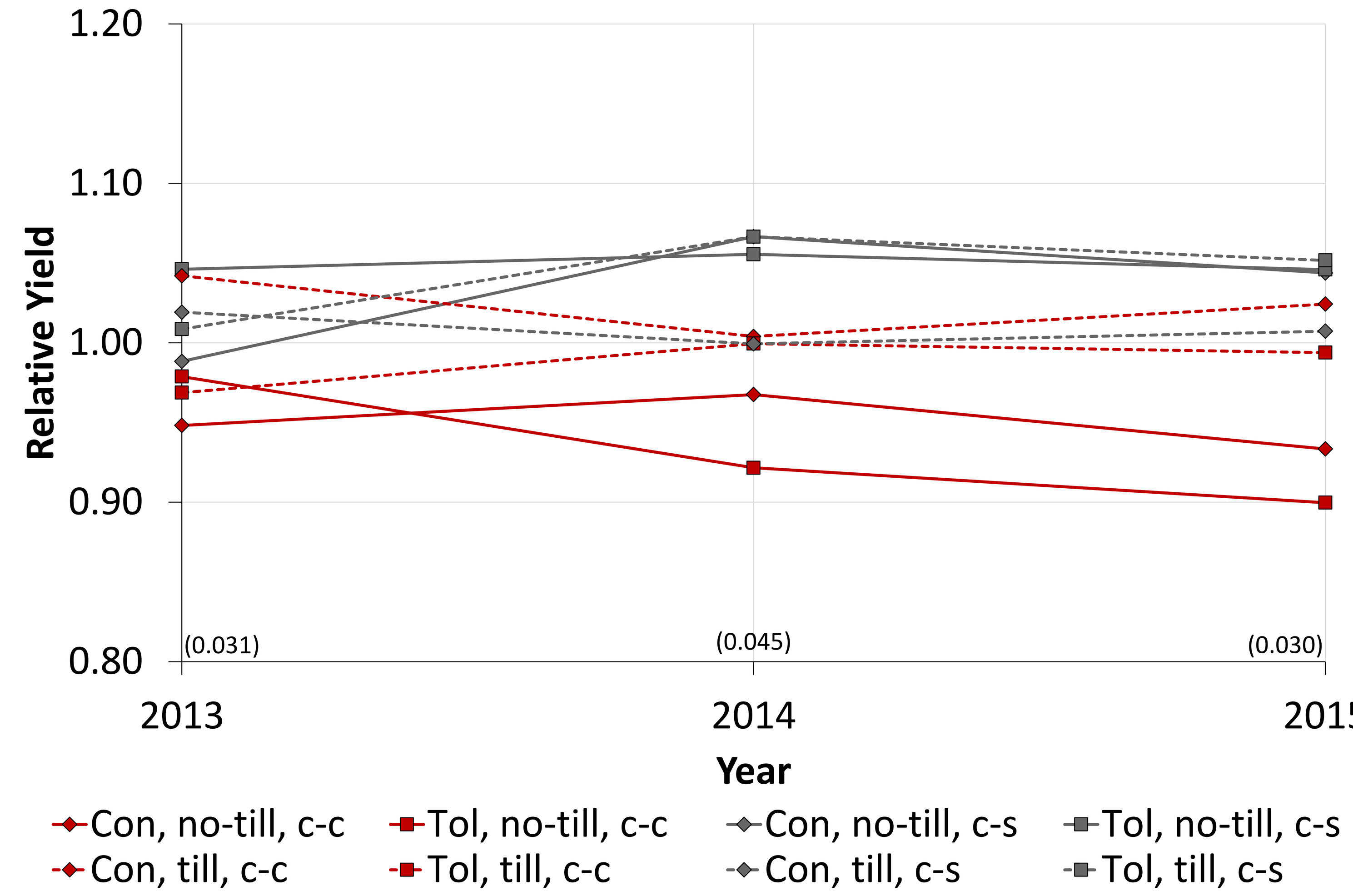

Figure 1. Relative yield over time at South Charleston for conventional (Con) and drought-tolerant (Tol) hybrids under tillage (till) or no-till production in continuous corn (c-c) or corn-soybean (c-s) rotation. The value in parentheses is the standard error for each point within a year.

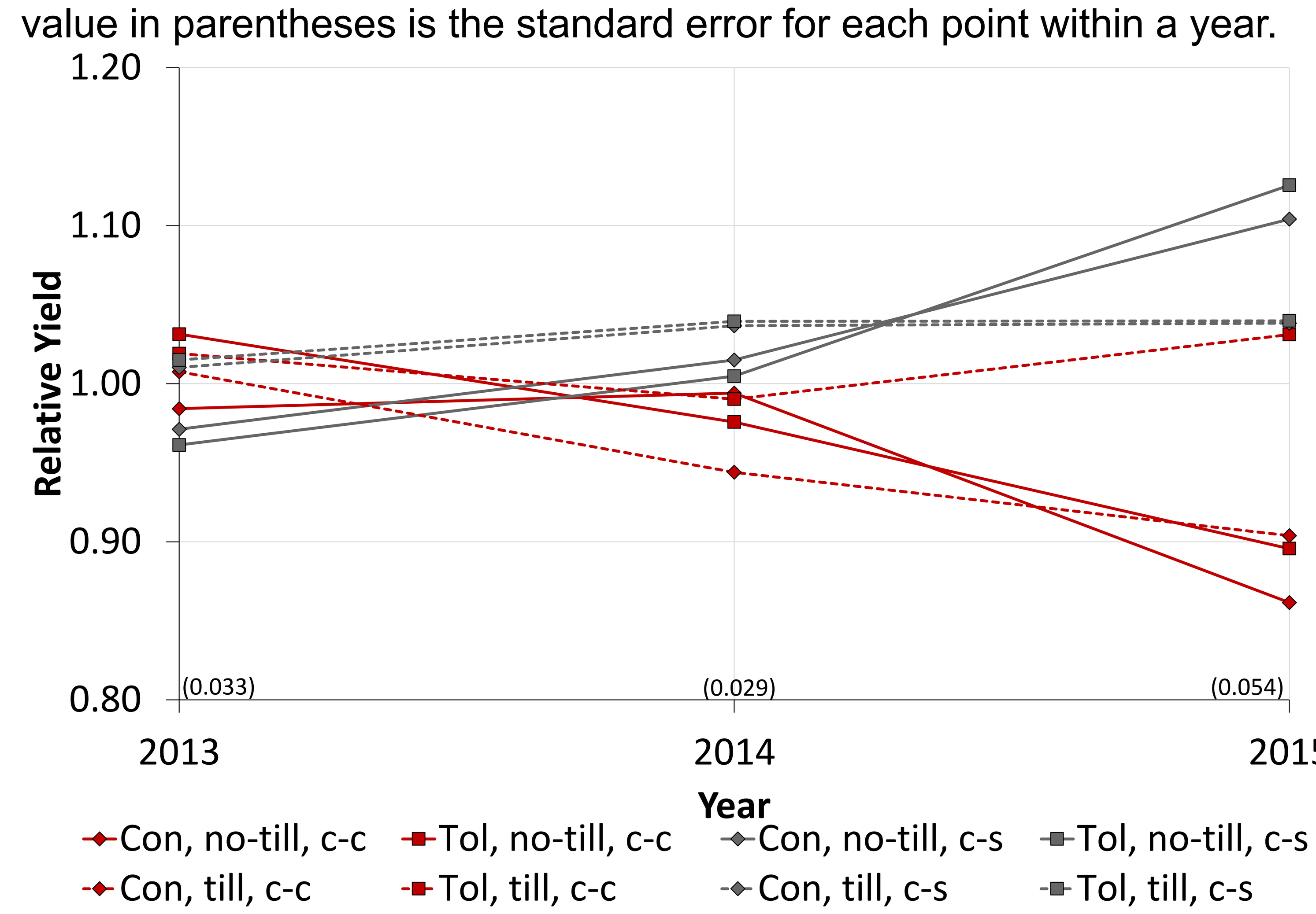

Figure 2. Relative yield over time at Hoytville for conventional (Con) and drought-tolerant (Tol) hybrids under tillage (till) or no-till production in continuous corn (c-c) or corn-soybean (c-s) rotation. The value in parentheses is the standard error for each point within a year.

CONCLUSIONS

- Rotation of corn with soybean resulted in a consistent yield increase (3-15%).
- Across years, there was a significant hybrid type by rotation interaction.
  - Drought-tolerant hybrids produced greater yield in rotation at South Charleston
  - Drought-tolerant hybrids produced greater yield in continuous corn at Hoytville
- Results suggest drought-tolerant hybrids may be more tolerant of continuous corn production in heavy clay soils.
- Future evaluations with other hybrid pairs should be conducted to further validate these results.

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